



DECLARATION

I, Takahiro SHIMIZU of Ark Mori Building, 13F, 12-32, Akasaka 1-chome, Minato-ku, Tokyo 107, Japan, do hereby certify that I am conversant with the English and Japanese languages and am a competent translator thereof, and I further certify that to the best of my knowledge and belief the following is a true and correct translation made by me of the Japanese specification JP2002-184981 as filed attached hereto.

Signed this 28th day of December, 2004

A handwritten signature in black ink, consisting of a large, stylized 'S' followed by a horizontal line and a long, sweeping flourish. The signature is written over a solid horizontal line.

Takahiro SHIMIZU

PATENT OFFICE
Japanese Government

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the following application as filed with this office.

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[Title of the Invention] FUEL CELL POWERED ELECTRIC
VEHICLE

[Claims]

[Claim 1] A fuel cell powered electric vehicle having a fuel cell which is controlled to be maintained at a predetermined temperature and an electricity storing apparatus for storing electricity generated by the fuel cell, the fuel cell powered electric vehicle being characterized in that:

the fuel cell and the electricity storing apparatus are stored in a common box and are disposed under a floor of a passenger compartment; and comprising:

a separation plate for separating the fuel cell from the electricity storing apparatus; and

a through hole for establishing a communication between the electricity storing apparatus and the passenger compartment, whereby

the electricity storing apparatus is cooled by air in the passenger compartment which has passed through the through hole to arrive thereat.

[Claim 2] A fuel cell powered electric vehicle as set forth in Claim 1, wherein a heat insulating material is provided on the separation plate.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Belongs]

The present invention relates to a fuel cell powered electric vehicle having a fuel cell and an electricity storing apparatus for storing electricity generated by the fuel cell, and more particularly to a fuel cell powered electric vehicle having a structure in which the fuel cell and the electricity storing apparatus are arranged side by side via a separation plate therebetween.

[0002]

[Prior Art]

Conventionally, in fuel cell powered electric vehicles, a fuel cell stack which is controlled to be maintained at a high temperature is disposed at a front nose part or under a floor of a passenger compartment of the vehicle, and the electricity storing apparatus for temporarily storing electricity generated by the fuel cells is disposed separately from the fuel cell stack at a different location such as a trunk at a rear part of the vehicle since the apparatus is controlled to be maintained at a low temperature.

[0003]

Fig. 3 shows a conventional arrangement of a fuel cell and an electricity storing apparatus on a fuel cell powered electric vehicle (hereinafter, also referred to

as a vehicle). A fuel cell system 32 (hereinafter, also referred to as a fuel cell) including a fuel cell stack 31 is stored at a front nose portion 35 of a vehicle 30 and is cooled using its own cooling line. This fuel cell system 32 is constructed to store, in addition to the fuel cell stack 31, a humidifier, a heat exchanger and an electricity generation control circuit, which are not shown, in the same box. In addition, an electricity storing apparatus 33 is stored in a trunk 36 and is cooled using its own cooling line. As this occurs, the fuel cell stack 31 and the electricity storing apparatus 33 are connected by high voltage wiring 34.

[0004]

[Problems that the Invention is to Solve]

However, while the cooling of the fuel cell and the electricity storing apparatus according to their controlled temperatures can be facilitated using their own cooling lines, since the fuel cell and the electricity storing apparatus are disposed away from each other at the different locations, there is caused a problem that the volume, weight and costs of the whole system are increased.

[0005]

In addition, the high voltage wiring between the fuel cell and the electricity storing apparatus is forced

to be long, and this causes a problem that the layout of the wiring becomes complex and the power loss is increased.

[0006]

The invention was made to solve the problems and an object thereof is to provide a fuel cell powered electric vehicle which can make the fuel cell and the electricity storing apparatus for storing electricity generated by the fuel cell lighter in weight and smaller in size, the high voltage wiring shorter in length and the production costs lower, and furthermore, which can allow the fuel cell and the electricity storing apparatus to be cooled effectively.

[0007]

[Means for Solving the Problems]

With a view to attaining the object, according to a first aspect of the invention, there is provided a fuel cell powered electric vehicle having a fuel cell which is controlled to be maintained at a predetermined temperature and an electricity storing apparatus for storing electricity generated by the fuel cell, the fuel cell powered electric vehicle being characterized in that the fuel cell and the electricity storing apparatus are stored in a common box and are disposed under a floor of a passenger compartment, and comprising a separation

plate for separating the fuel cell from the electricity storing apparatus and a through hole for establishing a communication between the electricity storing apparatus and the passenger compartment, whereby the electricity storing apparatus is cooled by air in the passenger compartment which has passed through the through hole to arrive thereat.

[0008]

According to the first aspect of the invention, the fuel cell and the electricity storing apparatus can be disposed together in the box under the floor of the passenger compartment by separating the fuel cell and the electricity storing apparatus so disposed in the interior of the box with the separation plate, whereby the weight, size and costs of the fuel cell and the electricity storing apparatus can be made lighter, smaller and lower, respectively. Furthermore, the length of the high voltage wiring between the fuel cell and the electricity storing apparatus can be made shorter and hence, the power loss can also be made smaller by disposing the fuel cell and the electricity storing apparatus in the common box.

[0009]

Furthermore, the electricity storing apparatus having the relatively lower controlled temperature can

be cooled by the air within the passenger compartment, and the fuel cell having the relatively higher controlled temperature which is different from the controlled temperature of the electricity storing apparatus can be cooled by a separate cooling line, whereby the fuel cell and the electricity storing apparatus can effectively cooled to there own controlled temperatures.

[0010]

In addition, the fuel cell and the electricity storing apparatus can be protected against damage by external force by disposing them in the common box.

[0011]

According to a second aspect of the invention, there is provided a fuel cell powered electric vehicle as set forth in the first aspect of the invention, wherein a heat insulating material is provided on the separation plate.

[0012]

According to the second aspect of the invention, since the heat insulating material is provided on the separation plate, a proper heat insulation can be provided between the fuel cell and the electricity storing apparatus which have the different controlled temperatures, and the cooling efficiency can be improved to thereby provide an effective cooling. In other words,

even when the fuel cell and the electricity storing apparatus are disposed close and adjacent to each other, since influence of heat generated by the fuel cell on the electricity storing apparatus or vice versa is interrupted by the insulating material, temperature controls at different temperature bands can easily be implemented.

[0013]

[Mode for Carrying out the Invention]

Referring to the accompanying drawings, an embodiment of a fuel cell powered electric vehicle according to the invention will be described. Fig. 1 shows an arrangement of a fuel cell system and an electricity storing apparatus of a fuel cell powered electric vehicle according to an embodiment of the invention, in which Fig. 1A is a plan view and Fig. 1B is a left side view of the vehicle. As shown in Fig. 1, in a fuel cell powered electric vehicle 10 having a fuel cell system 12 including a fuel cell stack 11 constituted by a plurality of stacked flat plate-like fuel cells and an electricity storing apparatus 13 for storing electricity generated by the fuel cell system 12, the fuel cell system 12 and the electricity storing apparatus 13 are stored in a common box 14 and are disposed under a floor 21 of a passenger compartment 20, and a separation plate 15 is provided

to separate the fuel cell system 12 and the electricity storing apparatus 13 stored in the interior of the box 14 from each other. Furthermore, heat insulating materials 18, 18 are affixed to front and back of the separation plate 15.

[0014]

This fuel cell system 12 generates electricity through electrochemical reaction between hydrogen and oxygen supplied from a hydrogen supply source constituted by a high pressure tank, not shown, and an air supply source constituted by a compressor, respectively. Electricity so generated is then supplied to a driving motor, not shown, so as to drive the fuel cell powered electric vehicle.

[0015]

In addition, the electricity storing apparatus 13 is able to store part of electricity generated by the fuel cell, and in particular, stores surplus generated output that is generated when the speed of the fuel cell powered electric vehicle is decreased. Furthermore, the power so stored is supplied to the driving motor when the fuel cell powered vehicle is accelerated so as to assist the fuel cell.

[0016]

This electricity storing apparatus 13 is provided

to be situated substantially directly below a rear seat 19 via the floor 21 of the passenger compartment 20, and refrigerant inlet ports 16 and a refrigerant outlet port 17 are made to open to the interior of the passenger compartment 20 via through holes, which will be described later on, so that air within the passenger compartment 20 can be circulated as a refrigerant.

[0017]

Fig. 2 is an enlarged sectional view showing the arrangement of the fuel cell system and the electricity storing apparatus. In Fig. 2, the fuel cell system 12 and the electricity storing apparatus 13 in the interior of the box 14 is separated by the separation plate 15, and the heat insulation materials 18, 18 are affixed to the separation plate 15, this allowing the fuel cell system 12 and the electricity storing apparatus 13 to be heat separated from each other.

[0018]

Since the fuel cell generates heat when electricity is generated through electrochemical reaction of hydrogen and oxidant, cooling water is circulated through the fuel cell system 12 by a cooling means such as a cooling pump 23, and the cooling water is allowed to be cooled by a cooling device such as a radiator, not shown, whereby the fuel cell system 12 is controlled to be cooled to

the predetermined temperature.

[0019]

The electricity storing apparatus 13 is constituted by, for example, an electric double layer capacitor or a secondary battery and is made to enable the storage of part of electricity generated by the fuel cell. In addition, the electricity storing apparatus 13 generates heat through electrochemical reaction or electric resistance when electricity is charged and discharged. Due to this, through holes 24, 25 are provided in the floor 21 of the passenger compartment 20 for the electricity storing apparatus 13 so that communications are established between the refrigerant inlet ports 16 and the refrigerant outlet port 17 of the electricity storing apparatus 13 and the passenger compartment 20. Furthermore, a fan 22 is provided in the refrigerant outlet port 17 for discharging air within the electricity storing apparatus 13 into the passenger compartment 20. As this occurs, since the electricity storing apparatus 13 has the refrigerant inlet ports 16 and the refrigerant outlet port 17, air within the electricity storing apparatus 13 is discharged into the passenger compartment 20 via the through hole 25, and air within the passenger compartment 20 is drawn into the electricity storing apparatus 13 via the through holes 24. In addition, the

refrigerant inlet ports 16 and the refrigerant outlet port 17 are disposed at predetermined angles so that the air discharged into the passenger compartment 20 via the through hole 25 does not enter the refrigerant inlet ports 16 directly from the refrigerant outlet port 17.

[0020]

The air drawn in from the refrigerant inlet ports 16 as refrigerant cools the electricity storing apparatus 13 and is then discharged into a space below the rear seat 19 in the passenger compartment 20 through the through hole 25 formed in the floor 21 of the passenger compartment 20.

[0021]

Next, the function of the fuel cell powered electric vehicle that is constructed as has been described heretofore will be described. As shown in Fig. 2, since the fuel cell system 12 and the electricity storing apparatus 13 stored in the interior of the box 14 are separated from each other by the separation plate 15, the fuel cell system 12 is allowed to have its own cooling means and is controlled to be maintained at a controlled temperature ranging from about 60 to 80.C by the cooling pump 23 and a pump control means, not shown.

[0022]

In addition, the refrigerant outlet port 17 of the

electricity storing apparatus 13 is made to open toward the passenger compartment 20, and air within the electricity storing apparatus is discharged into the passenger compartment 20 through the through hole 25 formed in the floor 21 of the passenger compartment 20 by the fan 22 provided in the refrigerant outlet port 17 so opened. As this occurs, since the electricity storing apparatus 13 has the refrigerant inlet ports 16 and the refrigerant outlet port 17, air within the electricity storing apparatus 13 is discharged into the passenger compartment 20 from the refrigerant outlet port 17 through the through hole 25, and air within the passenger compartment 20 is drawn into the electricity storing apparatus 13 from the through holes 24 via the refrigerant outlet ports 16, whereby the electricity storing apparatus 13 is controlled to be maintained at a controlled temperature ranging from about 40 to 50.C which is lower than that of the fuel cell system 12.

[0023]

Air thus discharged from the refrigerant outlet port 17 of the electricity storing apparatus 13 is allowed to pass through the through hole 25 formed in the floor 21 of the passenger compartment 20 to be discharged below the rear seat 19 in the passenger compartment 20, so that it can circulate between the passenger compartment 20

and the electricity storing apparatus 13.

[0024]

In addition, the fuel cell system 12 and the electricity storing apparatus 13 are separated by the separation plate 15 inside the box 14, the interior of the box 14 being thus divided by the separation plate 15 into respective sealed structures, and the heat insulating materials 18, 18 are affixed to the separation plate 15, so that the fuel cell system 12 and the electricity storing apparatus 13 are heat insulated from each other, whereby the transfer of heat from the fuel cell system 12 having the relatively higher temperature than that of the electricity storing apparatus 13 is made difficult, thereby making it possible to prevent the increase in temperature of the electricity storing apparatus 13.

[0025]

In addition, since the fuel cell system 12 and the electricity storing apparatus 13 are stored together in the box 14, the length of the high voltage wiring (not shown) can be made short, whereby the power loss can be reduced.

[0026]

Additionally, condition-controlled air within the passenger compartment 20 can be utilized by putting the

refrigerant inlet ports 16 and the refrigerant outlet port 17 of the electricity storing apparatus 13 having the relatively lower controlled temperature through the floor 21 of the passenger compartment 20 for communication with the passenger compartment 20, thereby making it possible to cool the electricity storing apparatus 13 effectively.

[0027]

Furthermore, since the fuel cell system 12 and the electricity storing apparatus 13 are installed under the floor of the passenger compartment 20, the fuel cell system 12 and the electricity storing apparatus 13 are prevented from being affected by direct sunlight, whereby the temperatures of the fuel cell system 12 and the electricity storing apparatus 13 are made difficult to be increased even when the electric vehicle is left direct exposed to strong sunlight.

[0028]

Thus, the condition-controlled air within the passenger compartment 20 can be utilized by putting the refrigerant inlet ports 16 and the refrigerant outlet port 17 of the electricity storing apparatus 13 having the relatively lower controlled temperature through the floor 21 of the passenger compartment 20 for communication with the passenger compartment 20, thereby making it

possible to cool the electricity storing apparatus 13 effectively.

[0029]

In addition, since the separation plate 15 is provided so as to separate the fuel cell system 12 and the electricity storing apparatus 13 in the interior of the box 14 from each other, the fuel cell system 12 and the electricity storing apparatus 13 which have the different controlled temperatures can be cooled using the separate cooling lines, and the fuel cell system 12 and the electricity storing apparatus 13 can be united together to form a unitary body via the separation plate 15, whereby the service and maintenance of the system and the apparatus can be implemented effectively. Furthermore, by uniting the system and the apparatus together to form a unitary body, the rigidity of the box 14 can be increased, thereby making it possible to protect the fuel cell system 12 and the electricity storing apparatus 13 against damage resulting from external force.

[0030]

Additionally, since the through holes 24, 25 are formed below the rear seat 19 in the passenger compartment 20, the space of the passenger compartment 20 can be utilized effectively, and air discharged from the fan 22 is prevented from being applied direct to passengers.

[0031]

The embodiment that has thus been described heretofore is only an example for explaining the invention and hence, the invention is not limited to the aforesaid embodiment and can be modified in various ways without departing from the spirit and scope thereof. For example, while the invention is has been described by reference to the embodiment in which the electricity storing apparatus is cooled by discharging air as refrigerant into the passenger compartment using the fan, the fan may be disposed in the vicinity of the refrigerant inlet port so that air within the passenger compartment is drawn into the electricity storing apparatus from the refrigerant inlet port for cooling the electricity storing apparatus, and air as refrigerant may then be discharged into the passenger compartment.

[0032]

In addition, an apparatus which makes use of an electric double layer capacitor working based on the electric double layer principle or a nickel-combined cell can be applied as the electricity storing apparatus 13. Then, deteriorations in electrostatic capacity and life of the electricity storing apparatus can be prevented by taking countermeasures against high temperatures as has been described heretofore.

[0033]

[Advantages of the Invention]

As has been described heretofore, according to the first aspect of the invention, the fuel cell and the electricity storing apparatus can be disposed together within the box under the floor of the passenger compartment by separating the fuel cell and the electricity storing apparatus in the interior of the box from each other with the separation plate and hence allowing them to be cooled by the separate cooling lines, whereby the weight, size and costs of the fuel cell and the electricity storing apparatus can be made lighter, smaller and lower, respectively. Furthermore, the length of the high voltage wiring between the fuel cell and the electricity storing apparatus can be made shorter by disposing the cell and the apparatus together in the box. In addition, the deterioration in life of the electricity storing apparatus can be prevented by controlling the temperature of the electricity storing apparatus.

[0034]

According to the second aspect of the invention, since the heat insulating materials are provided on the separation plate, the fuel cell and the electricity storing apparatus which have the different controlled temperatures can be heat insulated from each other,

whereby the cooling efficiency can be improved, and effective cooling can be provided.

[Brief Description of the Drawings]

[Fig. 1]

Drawings showing an arrangement of a fuel cell system and an electricity storing apparatus according to an embodiment of the invention, in which Fig. 1A is a plan view and Fig. 1B a partially sectional left side view.

[Fig. 2]

An enlarged sectional view showing the arrangement of the fuel cell system and the electricity storing apparatus according to the embodiment of the invention.

[Fig. 3]

Drawings showing an arrangement of a fuel cell system and an electricity storing apparatus according to a conventional example, in which Fig. 3A is a plan view and Fig. 3B a left side view.

[Description of Reference Numerals]

10: fuel cell powered electric vehicle; 11: fuel cell stack; 12: fuel cell system; 13: electricity storing apparatus; 14: box; 15: separation plate; 16: refrigerant inlet port; 17: refrigerant outlet port; 18: insulating material; 19: rear seat; 20: passenger compartment; 21: floor; 22: fan, 23: pump; 24, 25: through hole.

[Designation of Document] Abstract

[Summary]

[Problem] To provide a fuel cell powered electric vehicle which can make a fuel cell and an electricity storing apparatus for storing electricity generated by the fuel cell lighter in weight and smaller in size, a high voltage wiring shorter in length and production costs lower, and furthermore, which can allow the fuel cell and the electricity storing apparatus to be cooled effectively.

[Means for Resolution] In a fuel cell powered electric vehicle 10 having a fuel cell system 12 and an electricity storing apparatus 13 for storing electricity generated by the fuel cell system 12, the fuel cell system 12 and the electricity storing apparatus 13 are stored in a common box 14 and are fixed to a lower side of a floor 21 of a passenger compartment 20, and a separation plate 15 is provided to separate the fuel cell system 12 and the electricity storing apparatus 13 stored in the interior of the box 14 from each other. In addition, through holes 24, 25 are provided in the floor 21 of the passenger compartment 20 for establishing communications between a refrigerant inlet port 16 and a refrigerant outlet port 17 of the electricity storing apparatus 13 and the passenger compartment 20.

[Selected Figure]

Fig. 2

~~23~~ ポンプ

~~24、25~~ 貫通孔

【書類名】 図面 DRAWINGS

【図1】 DOCUMENT

FIG. 1A

(a)

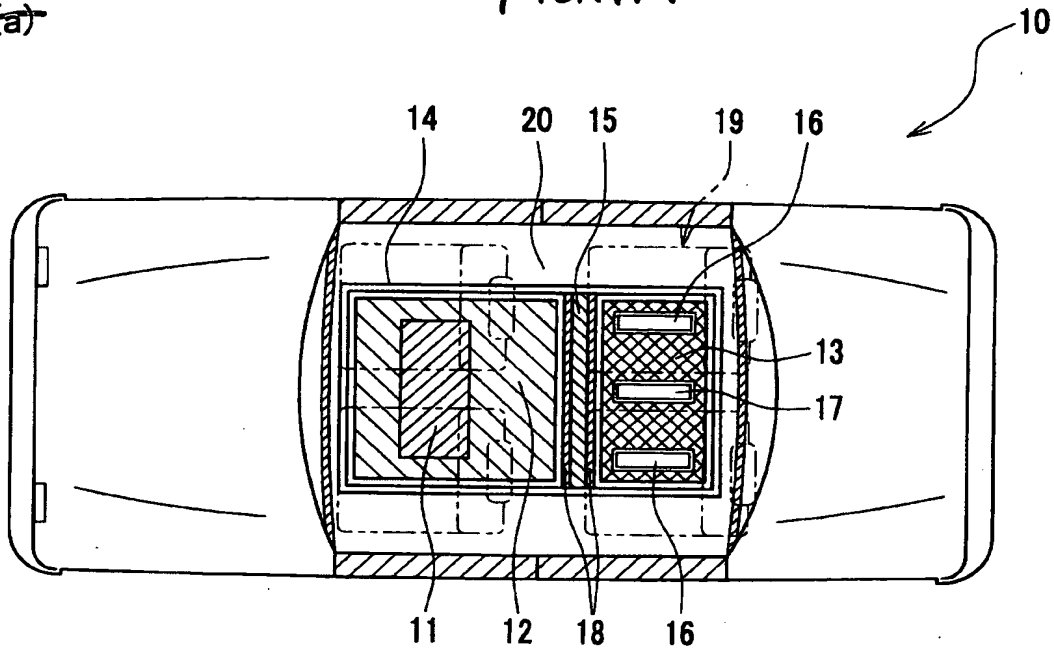
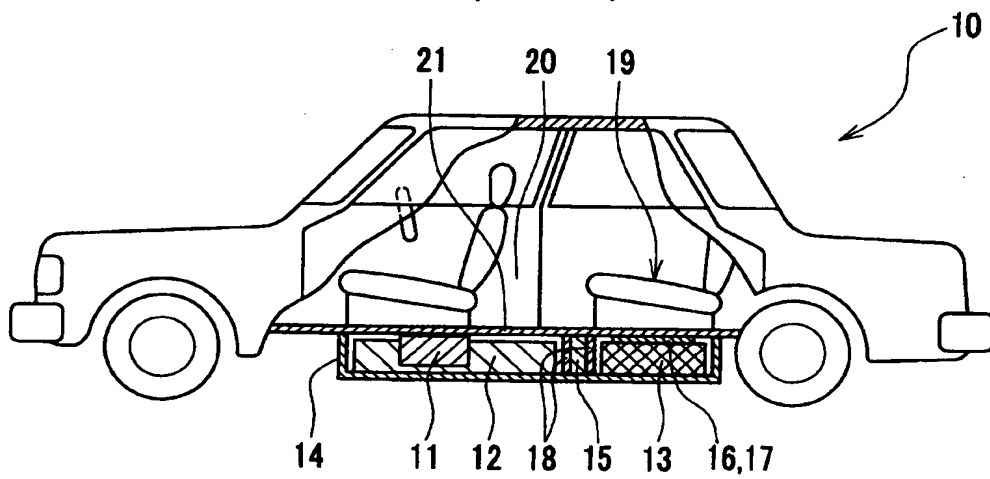


FIG. 1B

(b)



【図2】

FIG. 2

